

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

## WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

### FOR FURTHER ACTION

See paragraph 2 below

International application No. PCT/GB2004/001386	International filing date (day/month/year) 31.03.2004	Priority date (day/month/year) 01.04.2003
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International Patent Classification (IPC) or both national classification and IPC  
H04L1/06

Applicant  
QINETIQ LIMITED

#### 1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

#### 2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

#### 3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized Officer

Fernández Cuenca, B  
Telephone No. +49 89 2399-7019



**Box No. I Basis of the opinion**

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material:
    - a sequence listing
    - table(s) related to the sequence listing
  - b. format of material:
    - in written format
    - in computer readable form
  - c. time of filing/furnishing:
    - contained in the international application as filed.
    - filed together with the international application in computer readable form.
    - furnished subsequently to this Authority for the purposes of search.
3.  In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/GB2004/001386

**Box No. II Priority**

1.  The following document has not been furnished:

- copy of the earlier application whose priority has been claimed (Rule 43bis.1 and 66.7(a)).  
 translation of the earlier application whose priority has been claimed (Rule 43bis.1 and 66.7(b)).

Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2.  This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43bis.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

**Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or  
industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N) Yes: Claims 1-24  
No: Claims

Inventive step (IS) Yes: Claims  
No: Claims 1-24

Industrial applicability (IA) Yes: Claims 1-24  
No: Claims

2. Citations and explanations

**see separate sheet**

**Box No. VII Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**Box No. VIII Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

Reference is made to the following documents:

- D1: ABE T ET AL: "Space-time turbo equalization and symbol detection in frequency selective MIMO channels" VTC FALL 2001. IEEE 54TH. VEHICULAR TECHNOLOGY CONFERENCE. PROCEEDINGS. ATLANTIC CITY, NJ, OCT. 7 - 11, 2001, IEEE VEHICULAR TECHNOLOGY CONFERENCE, NEW YORK, NY : IEEE, US, vol. VOL. 1 OF 4. CONF. 54, 7 October 2001 (2001-10-07), pages 1230-1234
- D2: BIGLIERI E ET AL: "Recent results on coding for multiple-antenna transmission systems" IEEE, vol. 1, 6 September 2000 (2000-09-06), pages 117-121
- D3: EP-A-0 951 091 (LUCENT TECHNOLOGIES INC) 20 October 1999 (1999-10-20)
- D4: US-A-4 688 187 (MCWHIRTER JOHN G) 18 August 1987 (1987-08-18)

**Re Item I**

**Basis of the report**

The Written Opinion of the International Searching Authority is based on the following application documents:

Description: Pages 1-24 as originally filed

Claims: 1-20 as originally filed  
21-24 as amended under Article 19 PCT

Drawing sheets: 1/5-5/5 as originally filed

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. a. The wording "substantially simultaneously", on the line 3 of claim 1 is vague and imprecise, resulting in lack of clarity of the claims. For the assessment of novelty and inventive step, the term "substantially" has not been taken into account.

b. Claims 12 and 21 have been drafted as independent method claims. Nevertheless, they both appear to relate to the same subject-matter, being the scope of claim 12 broader. For these reasons, when assessing novelty and inventiveness, claim 21 has been considered as dependent on claim 12, and thus only the latter will be treated as independent.

This also applies to claims 23 and 24, which relate to computer implementations of claims 12 and 21, respectively. Only claim 23 will be considered as independent claim.

**2. Novelty (Article 33(2) PCT)**

a. D1, which is considered to represent the closest prior-art for the subject-matter of **claim 1**, discloses (the references between parentheses apply to this document):

A signal processing apparatus (figure 3) comprising

a plurality of receiving means (page 1230, right-hand column, second paragraph, lines 2-3) arranged to receive a composite signal indicative of a plurality of symbols transmitted (page 1230, right-hand column, second paragraph, lines 3-6; page 1231, left-hand column, lines 1-4),

from a plurality of remote transmission means (figure 1),

and processing means arranged to iteratively decode each most probable symbol contained in said composite signal (page 1230, right-hand column, lines 3-6)

from which the subject-matter of claim 1 basically appears to differ in that:

(I) decoding is performed within a constrained enumeration formalism.

The subject-matter of claim 1 is therefore novel (Article 33(2) PCT).

b. **Claim 12** is the method claim corresponding basically to the apparatus of claim 1, further comprising the features of:

- (I) calculation of possible conditional probabilities for one of the plurality of symbols (D1, page 1233, left-hand column, last two lines, to right-hand column, lines 1-4)
- (ii) iterating the process under paragraph (I) above, incorporating a most probable symbol for the one symbol determined in the previous iteration in the conditional probability calculation operation (D1, page 1233, right-hand column, paragraphs 1 and 2).

D1 does not disclose:

- (I) performing a QR factorization of the channel gain matrix.

Thus, the subject-matter of claim 12 is new (Article 33(2) PCT).

- c. Claim 23 is the corresponding computer-readable medium claim for the method of claim 12, and is also new.
- d. For the sake of completeness, reference is also made to D3, which discloses the same features as D1 (see relevant passages cited in the search report). Therefore, all argumentations given under section 3 below could also be made departing from the disclosure of D3.

### **3. Inventive step (Article 33(3) PCT).**

- a. The problem to be solved by the present invention may be regarded as how to improve the receiver known from D1 to decrease computational load when decoding a signal.
- b. The use of constrained formalisms in the field of signal processing, in particular in the field of processing signals coming from a plurality of receiving antennas is well-known in the art. By way of example, reference is made to D4, where, in columns 1 and 2, different constraint formalisms are described, which are applied to process inputs from a plurality of antennas in reception. Among the methods cited, a QR factorization is mentioned (D4, column 2, lines 61-67).

For these reasons, it would be obvious for the skilled person to implement a

constrained formalism in the system known from D1, thereby arriving at an apparatus like the one of claim 1 without any inventive activity, contrary to Article 33(3) PCT.

c. **Claim 12** relates to a method for processing MIMO signals. The problem to be solved is regarded also as reducing computational load.

D2 discloses, in the same technical context of the application, the QR factorization of the channel response matrix to reduce complexity at signal detection (page 120, left-hand column, lines 20-36).

Besides, QR factorization is considered as a well-known technique for processing matrixes, in particular, calculation of eigenvectors and eigenvalues; known also for its reduced complexity.

For these reasons, it would be obvious for the skilled person, when addressing the problem of reducing computational load at received signal processing, to combine the teachings of D1 with those of D2, thereby arriving at the subject-matter of claim 12 without any inventive activity, contrary to Article 33(3) PCT.

d. **Claim 23** is the corresponding computer readable medium claim, and thus its subject-matter is also not inventive.

e. **Dependent claims 2-11, 13-22 and 24** do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT with respect to inventive step, the reasons being as follows:

- (I) Claim 2: Obvious combination of D1 and D4 (see relevant passages for independent claims).
- (ii) Claim 3-5: Obvious combination of D1 and D2 (see relevant passages for independent claims).
- (iii) Claim 6: D1, page 1230, right-hand column, lines 6-12.
- (iv) Claims 7-8, 13: Common design procedure.
- (v) Claim 9: D1, page 1231, right-hand column, section III.A
- (vi) Claims 10 and 11: D1, page 1233, right-hand column, paragraphs 1 and 2.
- (vii) Claims 14-21 and 24 are equivalent method or computer readable medium

claims, therefore the argumentations given in paragraphs e.(I) to e.(vi) above also apply to these claims.

**Re Item VII**

**Certain defects in the international application**

The imprecise statement in the description on page 13, line 13, namely the wording "substantially similar", implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity of the claims (Article 6 PCT).

**Re Item VIII**

**Certain observations on the international application**

- a. The wording "substantially simultaneously", on the line 3 of claim 1 is vague and imprecise, resulting in lack of clarity of the claims, contrary to Article 6 PCT.
  
- b. Claims 12 and 21 have been drafted as independent method claims. Nevertheless, they both appear to relate to the same subject-matter, being the scope of claim 12 broader.